NASA/NSERC DC-8 Program
Current Status and Planned INTEX-B Integration and Mission

National Suborbital Education and Research Center (NSERC)
Northern Great Plains Center for People and the Environment
University of North Dakota
Grand Forks, North Dakota

Why is the DC-8 in North Dakota?

- NASA decided to transition the DC-8 program for more open access to perform research on the DC-8 for a number of reasons
- An RFP was issued and organizations proposed to operate the DC-8
- Dr. George Seielstad of the University of North Dakota proposed to have the university operate the DC-8 and include a research and education component
- The UND proposal was selected and in February 2005 Dr. Seielstad entrained some expertise to assist in the finalization of a plan to operate the DC-8 under a cooperative agreement with NASA
- June 1, 2005 a five year cooperative agreement was signed by UND and NASA and the National Suborbital Education and Research Center (NSERC) was established
- NSERC will operate the DC-8 for NASA from Grand Forks Air Force Base with a full time maintenance staff, some of which will be familiar to DC-8 investigators
- Dr. Seielstad is the director of the Northern Great Plains Center for People and the Environment which contains the Earth System Science and Policy program. His vision includes entraining students from the ESSP, Atmospheric Science, Engineering, and Aviation Science programs into the DC-8 program at UND

DC-8 Aircraft with new paint scheme

DC-8 Aircraft Specifications

AIRCRAFT DESCRIPTION:

- Crew: Two Pilots, Flight Engineer, Navigator
- Length: 157 feet
- Wingspan: 148 feet
- Engine: Four CFM56-2-C1 High Bypass Turbofan Jet
- Base: NSERC GFAFB Grand Forks, North Dakota

PERFORMANCE:

- Altitude: 1,000 - 41,000 feet
- Range: 5,400 Nautical miles
- Duration: up to 12 hours
- Speed: 425 - 490 knots True Air Speed (cruise)
- Payload: 30,000 lb.

ACCOMMODATIONS:

- Zenith, 8 and 62 Deg, and Nadir Viewports
- External Antenna Attachment Mounts
- Wing Pylons
- Optical Windows of various materials
- Air and Aerosol Sampling Probes
- Standard Equipment Racks 19-inch
- Laser Chiller Unit

SUPPORT: Dew/Frost Point Hygrometer

- Radar Altimeter
- Weather Radar
- GPS and Inertial Navigational Systems
- Time Code IRIG-B generation and distribution
- Data acquisition and display system
- Satcom downlink available
- Forward and Nadir Cameras and Digital Recording
- Both 400 Hz and 60 Hz Power
- Ten to Twelve Stations Available for Investigators

NSERC DC-8 Program Milestones

- 2/11/2005 Completion of last DC-8 science mission PAVE at NASA Dryden
- 6/1/2005 Five year Cooperative Agreement between NASA and the University of North Dakota signed which establishes the National Suborbital Education and Research Center (NSERC)
- 9/14/2005 NASA DC-8 ownership transferred from NASA DFRC to NASA GSFC/Wallops Island Flight Facility
  DC-8 transit to UND Aerospace at Grand Forks International Airport
- 10/1/2005 7-NSERC DC-8 maintenance staff positions filled
- 10/24/2005 NSERC staff complete a B Phase check on the DC-8 qualifying it to fly future science missions
- 10/31/2005 NSERC occupies Hangar 601 at GFAFB
- 11/4/2005 Transit of DC-8 to Grand Forks Air Force Base
- 11/7/2005 NSERC Opening ceremony at GFAFB
- 11/8/2005 DC-8 is housed in it's new home in Hangar 601

Upcoming 8 months of NSERC required tasks (in order of priority)

1. Modifications to NSERC DC-8 Hangar 601 11/1/2005-1/16/2006
2. Preparation for and participation in Interagency Aircraft Operation Panel (IAOP) review of the NSERC program 12/12-12/16 or 1/9-1/13
3. INTEX-B mission integration, test flights, deployment, and de-integration 1/17-5/20
4. Stardust rendezvous integration and mission 1/3-1/16
5. Quadrantids meteor showers integration and mission12/5/2005-1/3/2006

Status of Hangar 601 at GFAFB

- ~50,000 square foot hangar built in 1959
- Entire DC-8 aircraft fits inside the hangar
- Active foam fire suppression system
- Overhead radiant heat
- 3 large access doors for shipping truck access
- Office space for NSERC staff
- Newly resurfaced hangar floor

Hangar modifications planned before INTEX-B Integration

- Addition of 1600 sq ft of lockable bonded storage for DC-8 equipment on hangar floor
- Addition of ~2000 sq ft of modular laboratory space at the sides of the hangar
- Data network with wireless access for modular laboratories
- Cisco IP telephone system for offices and modular laboratories
- Compressed gas and flammable storage
- Fume hood for storage of hazardous chemicals

Location of GFAFB relative to Grand Forks

Grand Forks Air Force Base

Staying in Grand Forks, ND

- There are many choices for accomodations in Grand Forks
  - Most hotels have high speed Internet access
  - Hockey is a religion in North Dakota so reservations for home hockey game weekends will be problematic
- A large selection of restaurants (both chain and local) in Grand Forks provide a varied menu at quite reasonable prices
- Grand Forks has a mall with major chain department stores and specialty shops and building supply chain stores
- On GFAFB
  - VOQ housing may is an option on an available basis for US citizens only
  - Wellness facilities will be available to DC-8 investigator teams
  - Air Force base fast food restaurants are close to Hangar 601
- A complete listing of accommodations, restaurants, and business will be sent to all investigator teams soon

Grand Forks Air Force Base Security

- Unlike Moffet Field or Edwards Air Force Base, Grand Forks Air Force Base has no NASA presence so strict Air Force security procedures will be in effect
- All DC-8 investigators will need to have a number of background checks mandated by the Air Force Security staff
- The security checks and badging is a lengthy process
- US citizens need to provide Experimenter worksheets, a copy of passport, Air Force Form 74, and North Dakota Criminal Bureau of Investigation information waivers at least 45 days in advance
- Foreign nationals need to provide Experimenter worksheets, copies of passport, visas, greencard, Air Force Form 74, and North Dakota Criminal Bureau of Investigation information waivers at least 60 days in advance
- Foreign nationals need to escorted from the front gate to the NSERC hangar and need to be escorted anywhere on base by an NSERC badged employee
- US citizens need to be escorted from the parking lot across the active flight area to the hangar and back to parking
- All investigators will need to be driven in flight line vehicle from the hangar to the aircraft when it is on the active flight line

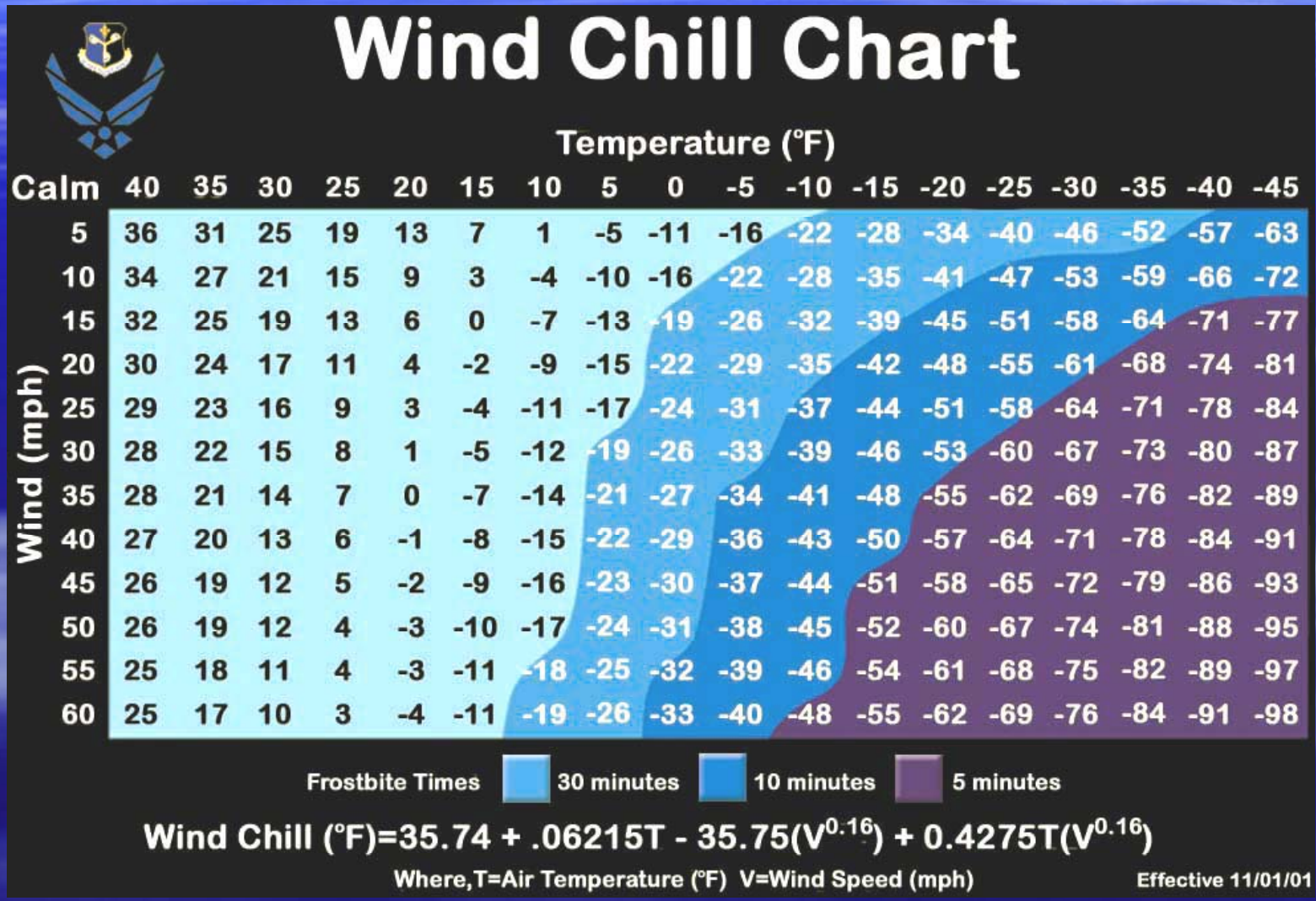
The COLD Hard Facts

- **TEMPERATURE AND WIND EXTREMES**
- The harsh realities of a northern winter can come as a shock to someone who has never experienced one…The following charts will give you an idea of the conditions you may experience in North Dakota:

	NOV	DEC	JAN	FEB	MAR	APR
Extreme Maximum Temperature	71	58	51	59	83	105
Extreme Minimum Temperature	-35	-37	-43	-44	-33	-9
Average Maximum Temperature	33	19	15	22	34	53
Average Minimum Temperature	27	3	-4	4	17	31
Maximum Wind Speed	46	51	47	50	46	47
Average precipitation (inches)	0.86	0.59	0.78	0.62	0.89	1.17
Average Number of Days/Month With:						
Temperature below 32 degrees	16	27	24	19	14	2
Temperature below 0 degrees	2	12	19	12	6	0

- The figures in the chart above are accurate, but they don't give you a "complete" picture. For example, four inches of snow really doesn't seem like much, but try to imagine that amount of snow being blown around by winds up to 70 mph. You could find you pathway blocked by three-foot drifts across the highway or you could find a gigantic mound of white angling upward from your driveway to the top of your garage. Even more disturbing will be the day you drive your car onto a nice flat shoulder of the road only to find the snow has drifted perfectly level over a six foot ditch.

Cold Hard Facts (continued)



INTEX-B Payload

	Experiment	PI/Organization	Measurements	Science	Transit	Test
1	PEROX	Brian Hiekes URI	Peroxides Formaldehyde	2	1	2
2	SAFS	Rick Shetter NCAR	Actinic Flux Photolysis Frequencies	0	1	1
3	DACOM	Glen Diskin LaRC	CH4, N2O, CO	1	2	2
4	DLH	Glen Diskin LaRC	Water Vapor	1	2	2
5	SAGA	Jack Dibb UNH	Soluble Acidic Gases and Aerosols, Hg	2	2	2
6	FastOZ	Melody Avery LaRC	Ambient Ozone	1	1	1
7	MACDONNA	Stephanie Vay LaRC	CO2	1	1	1
8	CRYO	John Barrick LaRC	Water Vapor	0	0	1
9	DCALS	Al Fried NCAR	Formaldehyde, methanol	1	1	2
10	UCI	Don Blake UCI	NMHC, Halocarbons	2	2	2
11	DIAL	Ed Browell LaRC	Vertical profiles of ozone and aerosol backscatter	3	3	4
12	PANAK	Hanwant Singh NASA ARC	PANs, OVOCs, nitrates,HCN, CH3CN	2	2	3
13	UHAG	Tony Clarke U Hawaii	Aerosols and aerosol properties	1	2	2
14	LARGE	Bruce Anderson LaRC	Aerosols and aerosol properties	1	1	2
15	ATHOS	Bill Brune Penn State	OH, HO2, Naphthalene, OH reactivity	1	1	1
16	TECHNO	Greg Huey GTRI	NO	0	0	1
17	GT-LIF	Dave Tan GTRI	NO Formaldehyde	3	2	3
18	TD-LIF	Ron Cohen UC Berkeley	NO2, thermally labile nitrates	1	2	2
19	GT CIMS SO2	Greg Huey GTRI	SO2, HO2NO2	1	1	1
20	AROTAL	Tom McGee GSFC	Vertical profile of ozone, temperature, aerosols	3	3	4
			Total Seats requested	27	30	39

Additional Requests

- Expanded Mission Scientist console with better displays and egress
- Satcom link for real time chat and weather product downloads in flight
  - During INTEX-A a 12 channel IRIDIUM system was flown as an engineering check
  - Possible to request a re-fly of the system on the DC-8
  - Requires a place for GPS antennas and control box
  - Requires a seat for an operator (next to ICATS operator?)
  - Costs of $1/minute/channel for satellite time a possible issue

Current INTEX-B Schedule (tentative)

11/1	Finalize DC-8 floorplan and instrument matrix based on meetings with experimenters
12/1	Preliminary Configuration Review Board (*Wallops staff*)
12/2-12/23	Identify and locate probes, brackets, racks and drawings for all instruments
12/19	Final CRB (*Wallops staff*)
12/20	Request engineering support for all changes and modifications
1/3	Start fabrication of needed brackets for modification
1/19	Begin upload with probes, optical windows, exhaust and electrical lines
1/21	Begin instrument rack upload
2/7	Electrical power check
2/8	Airworthiness Review Board (*Wallops staff*)
2/8-2/14	Lidar ground calibrations
2/15	Experimenter DC-8 systems safety brief
2/16	Engineering check flight
2/18	Mission Readiness Review
2/20	First investigator test flight
2/23	Second investigator test flight
2/26-2/27	Pack aircraft
2/28	Transit to Ellington field for start of INTEX-B mission
3/20	Pack aircraft
3/21	Transit to GFAFB for mid-mission break
4/14	Investigators arrive at GFAFB
4/16	Pack aircraft
4/17	Transit to Hickam AFB in Hawaii
4/29	Pack aircraft
4/30	Transit to Anchorage, AK
5/14	Pack aircraft
5/15	Transit to GFAFB for de-integration

Challenging issues ahead

- The extremely large payload only allows for 32 passenger seats
  - No seats are available in the cockpit due to pilot training
  - This seat total includes Mission Scientist, Mission Meteorologist, 2 DC-8 crew firemen, ICATS operator, and IRIDIUM operator **leaving only 26 seats** for investigator groups
  - Requests from investigators have a minimum of **27** seats requested for science flights and **39** for test flights and **30** for transit flights
- There are requests for a large number of compressed gas bottles to be flown on the aircraft
  - Limited space in the forward pit and in the main cabin may preclude all of the requests
  - "Downsizing" of gas bottles may allow for installation of some bottles in the main cabin but may require cylinder changes
- Engineering support not yet available at NSERC for modifications
- NASA Wallops operational and upload procedures must be followed for airworthiness, flight, and mission approvals
  - Legacy drawings and stress analysis must be located for all instruments, probes and brackets or re-engineered
  - NSERC has requested "grandfathering" of instruments, probes and brackets previously reviewed and approved when flown on the DC-8 at NASA Ames or NASA Dryden

Shipping and Receiving and Safety

- Commercial shipping of equipment to Hangar 601 at GFAFB is available
  - Addresses and instructions will be provided soon
- Hazardous and radioactive material shipments
  - The UND safety office may be able to receive all hazardous materials shipments and transport to GFAFB
- Laser safety procedures and necessary forms are being developed by the UND Safety office and will be distributed ASAP

Education and Outreach Activities at NSERC during INTEX-B

- A goal of entraining undergraduate and graduate students in various parts of the DC-8 operations and INTEX-B activities
- Establish a seminar series with short presentations by INTEX-B investigators
  - Ideally these presentations would give an overview of the instrumental technique and show data in context to INTEX-B goals
  - These presentation could appended to payload status meetings during integration
- The Earth System Science and Policy faculty would like to have access to DC-8 instrumental data when it is publically available to use in classroom activities
- Students from Atmospheric Science, Engineering, and Aviation Science departments would participate and observe integration activities
  - Observe flight planning processes
  - Observe Airworthiness review processes
  - Attend investigator team meetings
  - Participate in instrument uploads

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